

CLAIMS

1. A liquid crystal display apparatus comprising:

a liquid crystal display device having light modulating means, a first polarizing filter, arranged on the front surface of said light modulating means and a second polarizing filter arranged on the back side of said light modulating means, said light modulating means including a pair of transparent electrode plates and liquid crystals sealed therein;

a first light source arranged on the back side of said liquid crystal display device, said first light source having a polarizing filter unit for the right eye and a polarizing filter unit for the left eye, said polarizing filter unit for the right eye and a polarizing filter unit for the left eye having respective different directions of polarization and being fixedly mounted on left and right portions on a front surface thereof;

optical means arranged on the back side of said liquid crystal display device for collecting the illuminating light from said light source for illuminating the so-collected light on said liquid crystal display device;

a second light source arranged on the front side of said liquid crystal display device for illuminating the light on the head of a viewer;

light receiving devices arranged on the front sides of said polarizing filter unit for the right eye and the polarizing filter unit for the left eye at a preset spacing therefrom; and

position control means for processing and comparing the volumes of the received light in said light receiving devices to control the position of said first light source in the left-and-right direction; wherein

the image information for the right eye and that for the left eye are alternately displayed on said light modulating means every horizontal line in agreement with light transmitting lines in said first and second polarizing filters; the light illuminated from said first light source through said polarizing filter unit for the right eye is incident on the right eye of the user through said liquid crystal display device, the light illuminated from said first light source through said polarizing filter unit for the left eye is incident on the left eye of the user through said liquid crystal display device, independently of the light from said first light source through said polarizing filter unit for the right eye; the volume of light illuminated from said second light source and reflected by the head of the user is sensed by said light receiving devices to detect the movement in the left-and-right direction of the head of the viewer; said position control means causing automatic movement of the position of the first light source in the left-and-right direction in agreement with the detected movement.

2. The liquid crystal display apparatus according to claim 1 wherein said first and second polarizing filters each include two linear polarizing filter lines, perpendicular to each other, every horizontal line of said light modulating means, and wherein the facing linear polarizing filter lines of said first and second polarizing filters are formed in polarizing directions perpendicular to each other.

3. The liquid crystal display apparatus according to claim 1 wherein said first and second polarizing filters are linear polarizing filters having the same polarizing directions over the entire surfaces thereof but being perpendicular to each other, and wherein half wave plates are provided every other horizontal line in said second polarizing filter.
4. The liquid crystal display apparatus according to claim 1 wherein said second polarizing filter includes mutually perpendicular linear polarizing filter lines alternately arranged every horizontal line of said light modulating means;
said first polarizing filter being formed by a linear polarizing filter of the same direction as the direction of one of said linear polarizing filter lines of said second polarizing filter; and wherein
the driving states of said light modulating means for one horizontal lines having the same direction of polarization of said first and second polarizing filters are set reversely.
5. The liquid crystal display apparatus according to claim 1 wherein, in said position control means, the polarizing filter unit for the right eye and the polarizing filter unit for the left eye are arranged as a plural number of strip-shaped Brewster angle variable type polarizing devices to vary the boundary positions of the mutually perpendicular Brewster angles.
6. The liquid crystal display apparatus according to claim 1 wherein said position control means includes a motor for causing movement of said first light source.

7. The liquid crystal display apparatus according to claim 1 further comprising:
a mirror for reflecting the light emitted by said first light source to illuminate the reflected light to said light modulating means and for reflecting the light illuminated from said second light source and reflected by the user's head towards said light receiving device.
8. The liquid crystal display apparatus according to claim 7 further comprising:
a pair of side portions for clamping said mirror from both sides thereof.
9. The liquid crystal display apparatus according to claim 8 wherein the mirror and the paired side portions are connected for opening/closure to said light modulating means and wherein, when said light modulating means is driven, said mirror and the paired side portions are opened to clamp said mirror by said paired side portions.
10. A liquid crystal display device comprising:
first image separating means for separating the light illuminated from a light source depending on the direction of polarization;
light modulation means having liquid crystals sealed within a pair of transparent electrode plates, said light modulation means modulating the intensity of light transmitted through said first image separating means;
second image separating means for separating the light transmitted through said light modulating means depending on the direction of polarization; and
a pair of substrates for clamping at least said first image separating means and said modulating means.

11. The liquid crystal display device according to claim 10 wherein said first image separating means are independent from one horizontal line to another.
12. The liquid crystal display device according to claim 10 wherein said first and second polarizing filters are linear polarizing filters having the same polarizing directions over the entire surfaces thereof but being perpendicular to each other, and wherein half wave plates are provided every other horizontal line in said second polarizing filter.
13. The liquid crystal display device according to claim 10 wherein said second polarizing filter includes mutually perpendicular linear polarizing filter lines alternately arranged every horizontal line of said light modulating means;
said first polarizing filter being formed by a linear polarizing filter of the same direction as the direction of one of said linear polarizing filter lines of said second polarizing filter; and wherein
the driving states of said light modulating means for one horizontal lines having the same direction of polarization of said first and second polarizing filters are set reversely.
14. The liquid crystal display device according to claim 13 wherein said first image separating means includes an orientation layer oriented in a preset direction and a layer containing a polarizer, said polarizer containing layer being deposited on said orientation layer.
15. The liquid crystal display device according to claim 14 wherein said polarizer is

dichromic molecules.

16. The liquid crystal display device according to claim 12 wherein said dichromic molecules are density transition type liquid crystals.

17. The liquid crystal display device according to claim 10 wherein said second image separating means is constructed by alternately arranging layers with a circular polarization separator having respective different twist directions from one horizontal line to another, with a quarter wave plate being arranged on the front side of said layer; said second image separating means is formed by a linear polarizing filter having the same direction as the direction of one linear polarized light passed through said first image separating means; and wherein

the driving state of said modulating means are reversely set for horizontal lines for which the direction of polarization of linear light transmitted through said first image separating means is coincident with the second image separating means.

18. The liquid crystal display device according to claim 17 wherein circular polarized light separator is cholesteric liquid crystals.

19. The liquid crystal display device according to claim 10 wherein, with the distance between respective pixels of the light modulating means being B_L , the angle of the light incident on the light modulating means being θ , the distance between the respective pixels in said light modulating means and one of the first and second image separating means that is closer to said light modulating means being D_L , D_L satisfies the following relation (2):

$$D_L < B_1 / 2 \tan \theta$$

...(2).

20. A liquid crystal display system employing two, namely left and right polarizing filters having respective different directions of polarization, comprising:

a liquid crystal display device; said liquid crystal display device including:
first image separating means for separating the light illuminated from a light source depending on the direction of polarization;
light modulation means having liquid crystals sealed within a pair of transparent electrode plates, said light modulation means modulating the intensity of light transmitted through said first image separating means;
second image separating means for separating the light transmitted through said light modulating means depending on the direction of polarization; and
a pair of substrates for clamping at least said first image separating means and said modulating means.